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CLEAN HOUSEHOLD ENERGY & INDOOR AIR POLLUTION

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High social costs of traditional biomass use

- Drudgery of biomass collection
- Time consuming cooking
- Indoor and outdoor air pollution
- Diversion of time of women and children from more productive activities
- Physical and mental health problems
- Gender disparity
- Forest and soil degradation

Cooking, Indoor Air Pollution & Health



India Traditional Stove Near Bangalore



Indoor Air Pollution: Periurban Bangladesh



Collection Time and Drudgery



Venting Smoke: Improved Stove- Guatemala



Fuel Substitution: Kerosene and LPG Cooking Urban India



↑
Kerosene



LPG→

How are measurements taken? Lighting & Cooking Rural India

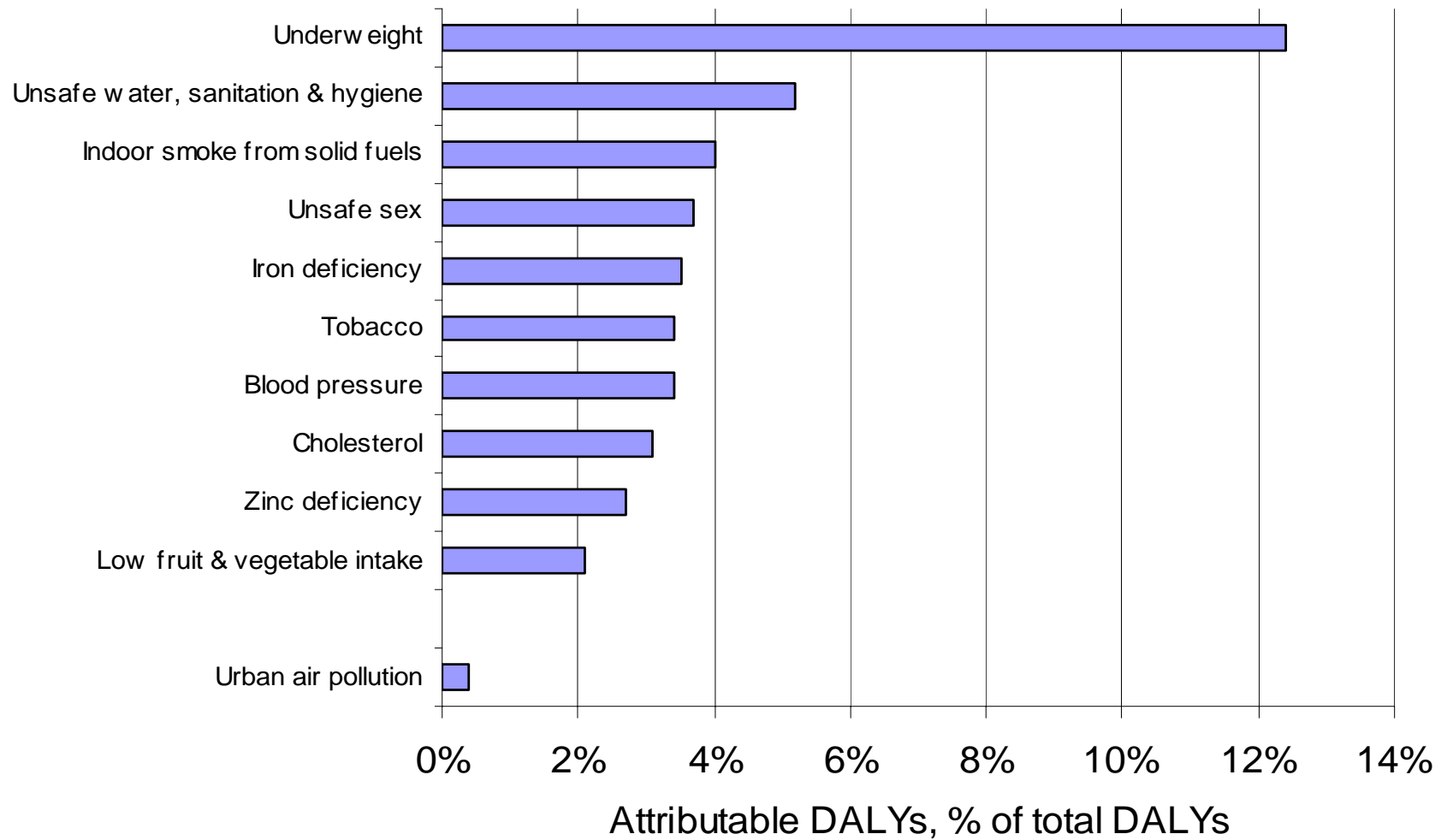




General Issues: Indoor Air Pollution (IAP) from solid fuels is a major health threat

- A leading cause of illness and death, according to World Health Report-2002 (WHO):
 - 8th top health risk worldwide
 - 4th top health risk in developing countries with high child mortality
 - 3rd top health risk in India, after malnutrition and water-borne diseases
- Particularly affects young children and women
 - Kills 1.6 million infants, young children and women worldwide each year
 - 420,000 or over 25 % of these deaths happen in India, mainly in rural areas
- An important factor for achieving [Millennium Development Goals \(MDG\)](#) of halving child mortality and improving maternal health

Burden of Disease attributable to 10 top risk factors (plus urban air pollution) in India, 2000





Are these estimates of health impacts believable? Yes...

- For example 70 % of India's households traditional biomass is the primary cooking fuel, and people spend most of their time indoors, especially women, young children and elderly
- Indoor concentrations and exposures to particulate matter and other harmful air pollutants in rural households using unprocessed solid fuels
 - exceed those in world's most polluted cities, and
 - are much higher than outdoor air quality health-based standards
- While highest in colder climate areas with high heating demand, exposure levels also significantly exceed health-based standards for "cooking only" households, even when cooking takes place outdoors
- In sum, a very large number of people are exposed to a very high level of air pollution inside their homes on a daily basis while strong scientific evidence links exposure to particulate matter and some other air pollutants to health effects



Key health effects linked to IAP

- ARI/ALRI (young children)
- Chronic bronchitis and COPD
- Lung cancer (coal only)
- Cataract - In India cataracts are highest among women
- Asthma
- Tuberculosis

Consistent evidence from:

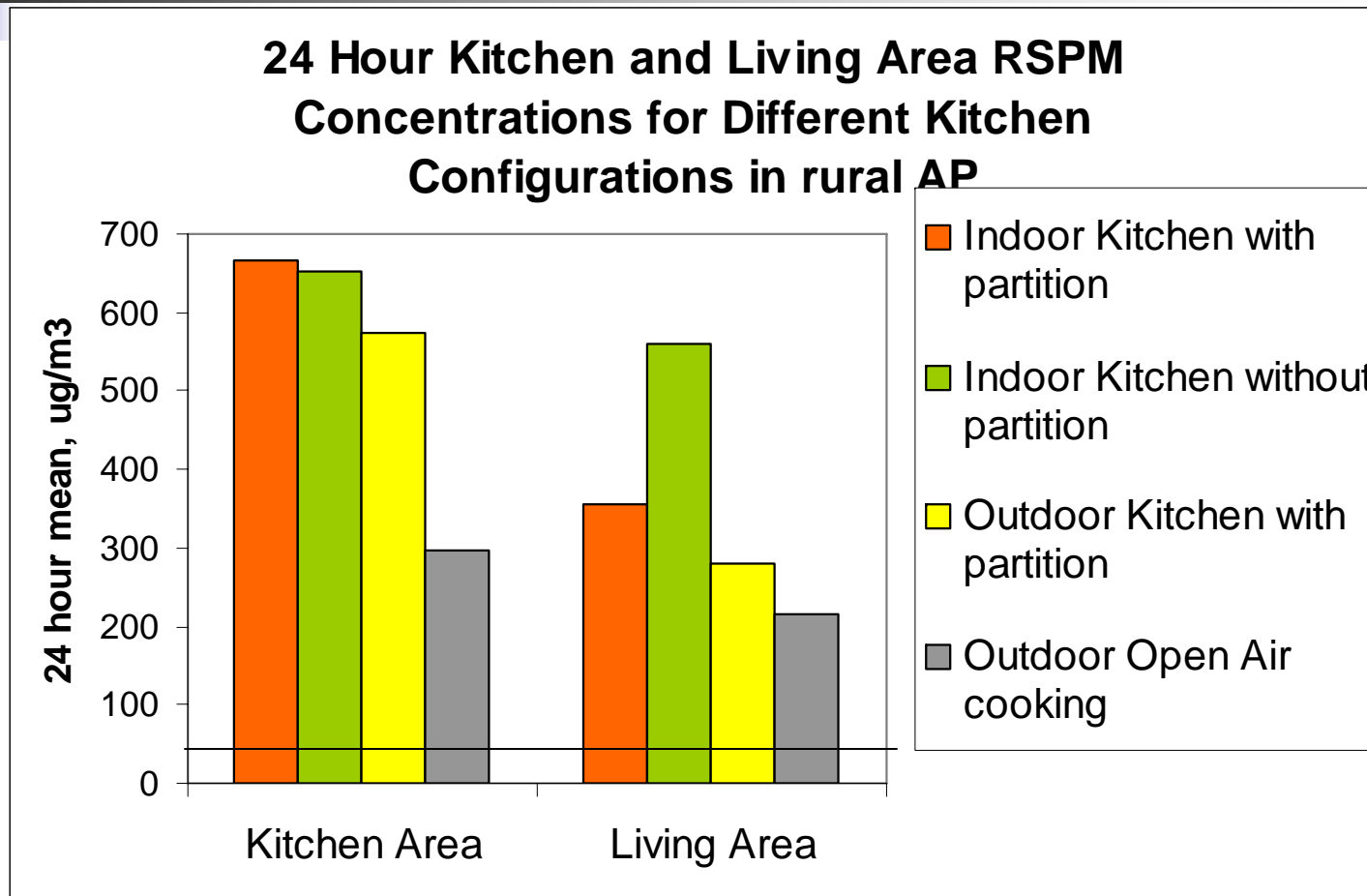
- A large body of outdoor air pollution studies
- Environmental tobacco smoke studies
- A rapidly increasing number of solid fuels/IAP studies in rural areas with largely consistent findings
- Cumulative evidence is sufficient to acknowledge the problem and justify action



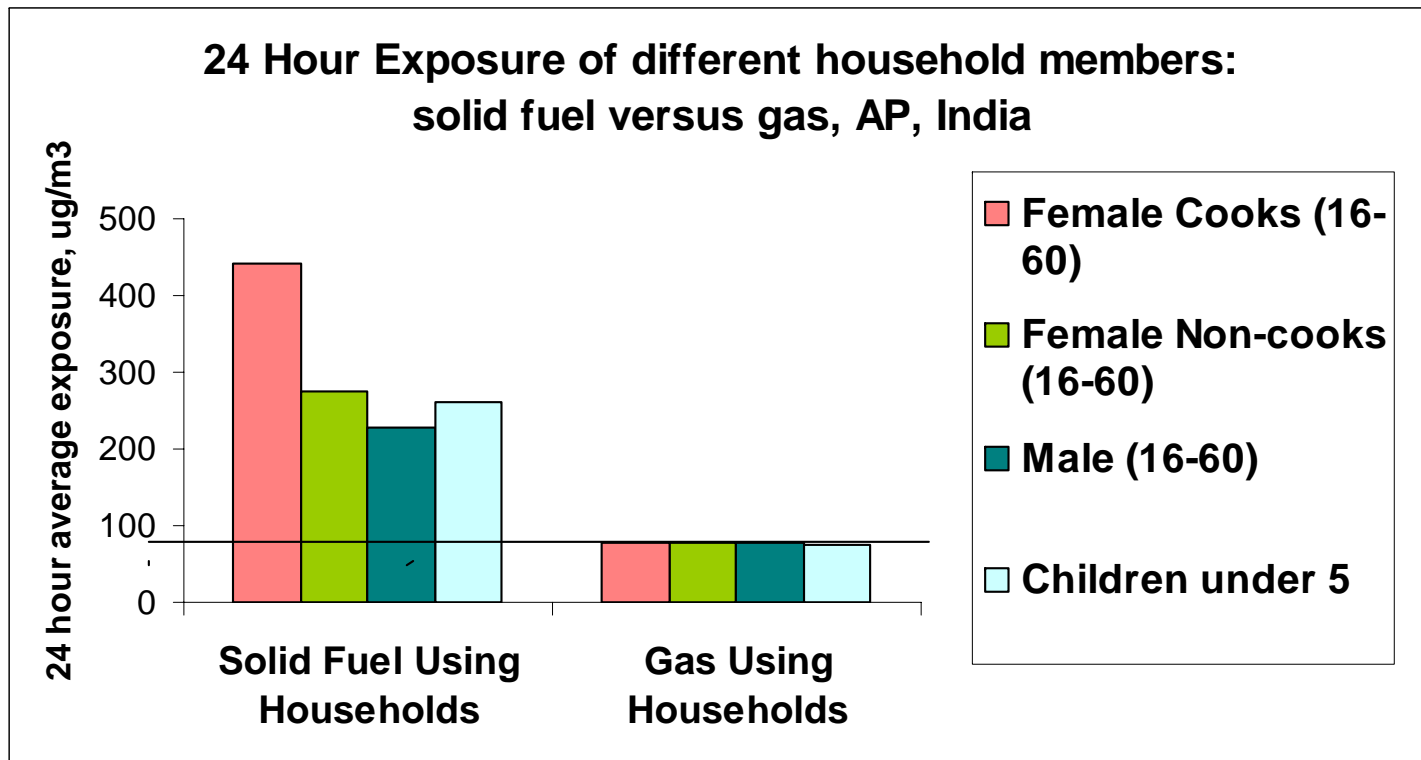
Household Energy, Indoor Air Pollution and Health

- India Study (Kseniya Lvovsky SASES)
 - Rural Andhra Pradesh 412 Households stratified by kitchen configuration (indoor outdoor etc.)
 - 270 HH using wood, 97 wood and dung, 34 LPG or biogas, 11 kerosene
 - PM4 or Respiratory Suspended Particulate Mater (RSPM) was measured
- Bangladesh Study (Susmita Dasgupta DECRG)
 - Indoor air quality (PM10) was monitored for a stratified sample of 236 households in Dhaka and Narayanganj using filters
 - PM2.5 was monitored for a subsample of 85 households using constant monitoring technique.

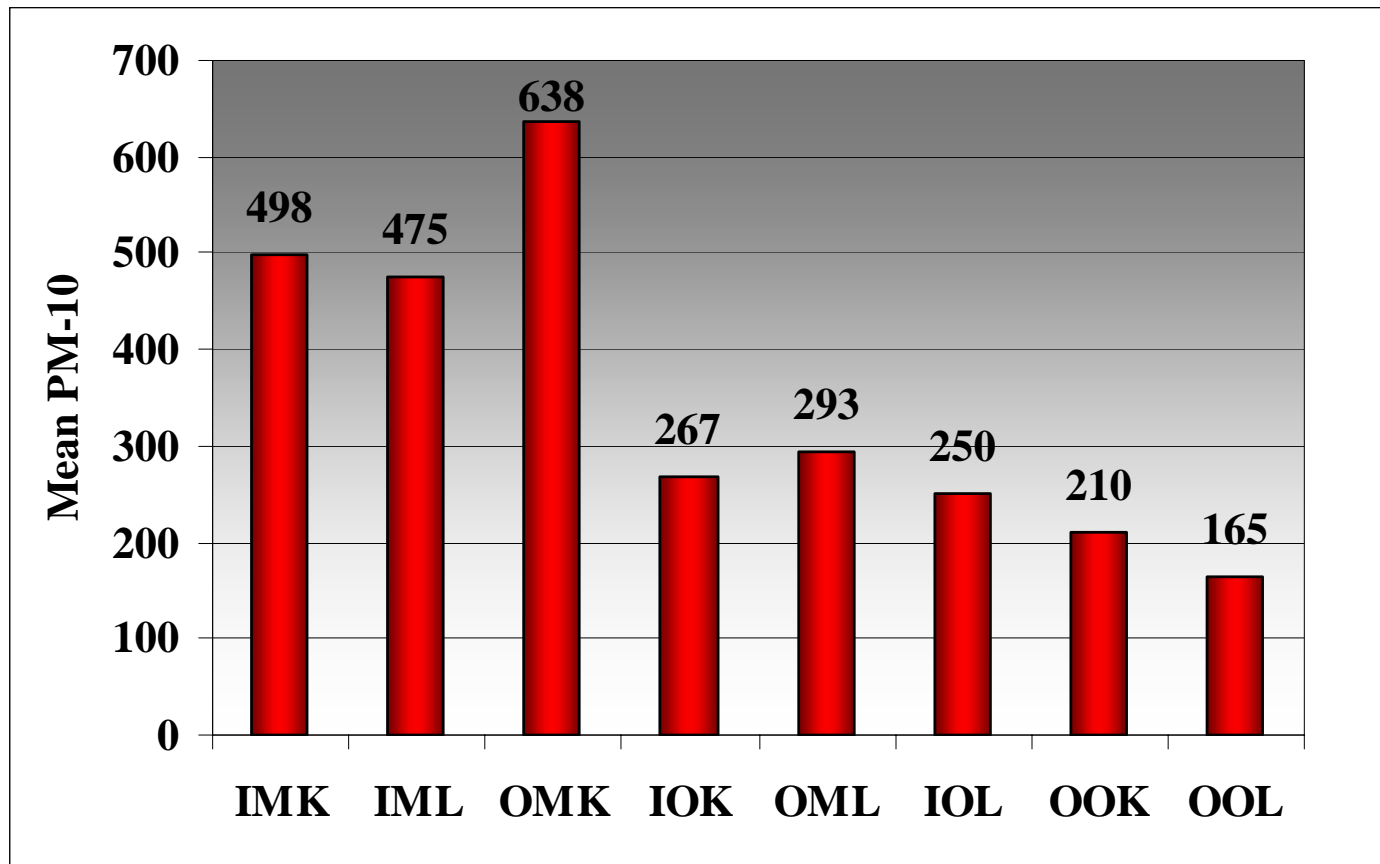
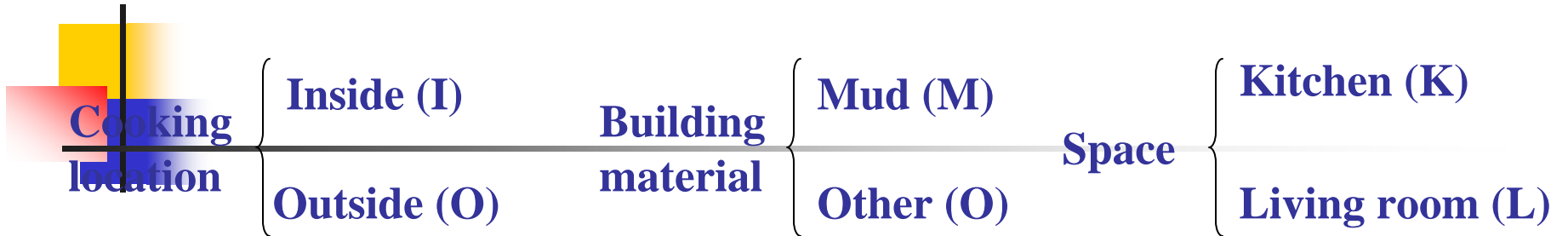
India Study: IAP mitigation impact of kitchen configuration

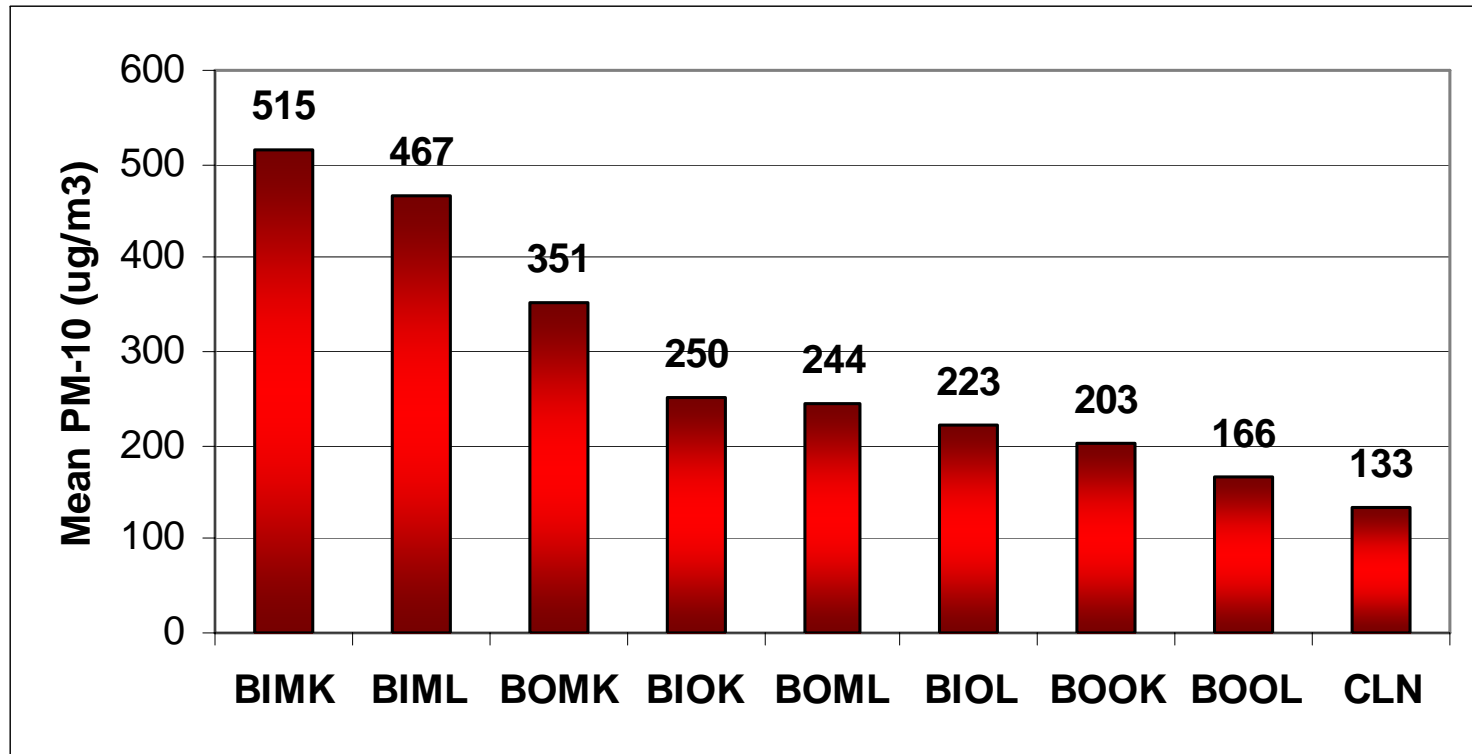
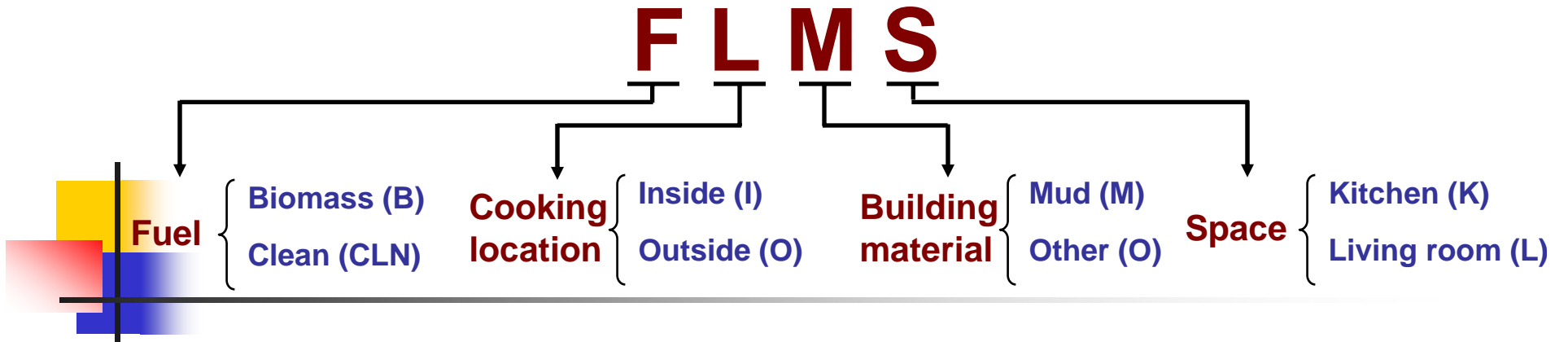


India Study IAP mitigation impact of switching to gaseous fuels




Bangladesh Study





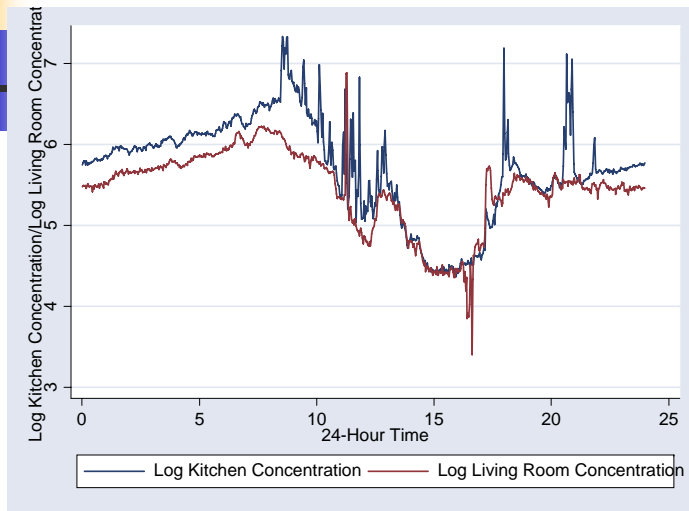
Bangladesh: Pollution Factors and PM10 Concentrations: All Fuels



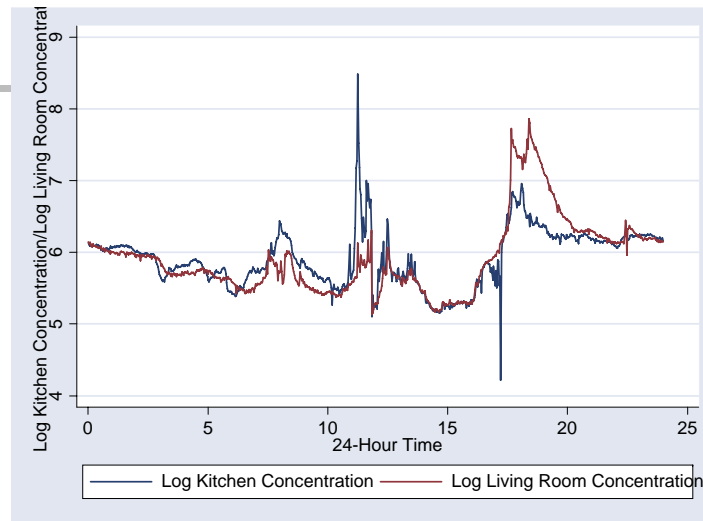
Fuel	Cooking Location	Building Material	Space	Abbrev.	Mean PM ₁₀	Median PM ₁₀	Houses	Difference in Mean (From BIOL)	t-statistic
Biomass	Inside	Mud	Kitchen	BIMK	515	528	23	292	11.15
Biomass	Inside	Mud	Living	BIML	467	453	20	244	8.86
Biomass	Outside	Mud	Kitchen	BOMK	351	258	22	128	4.81
Biomass	Inside	Other	Kitchen	BIOK	250	220	74	27	1.46
Biomass	Outside	Mud	Living	BOML	244	218	29	21	0.87
Biomass	Inside	Other	Living	BIOL	223	213	62		
Biomass	Outside	Other	Kitchen	BOOK	203	191	101	-20	-1.16
Biomass	Outside	Other	Living	BOOL	166	162	116	-57	-3.41
Clean				CLN	133	117	46	-90	-4.34
Overall					231	187	493		

Bangladesh: PM₁₀ concentrations in 4 houses: kitchens and living rooms

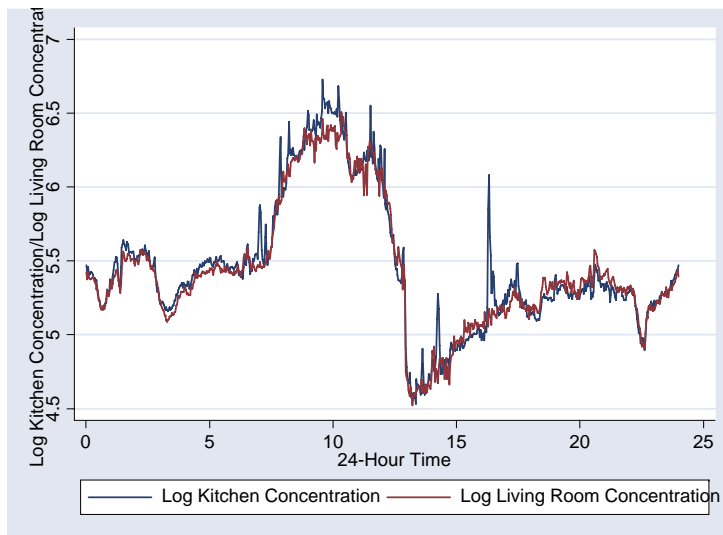
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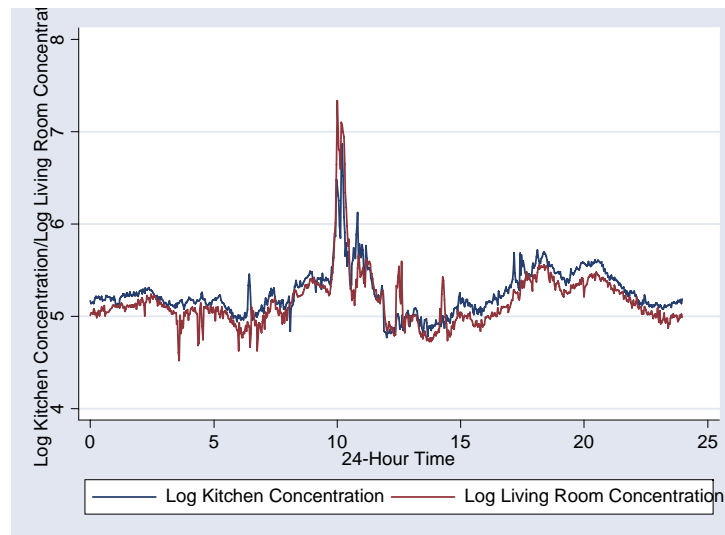
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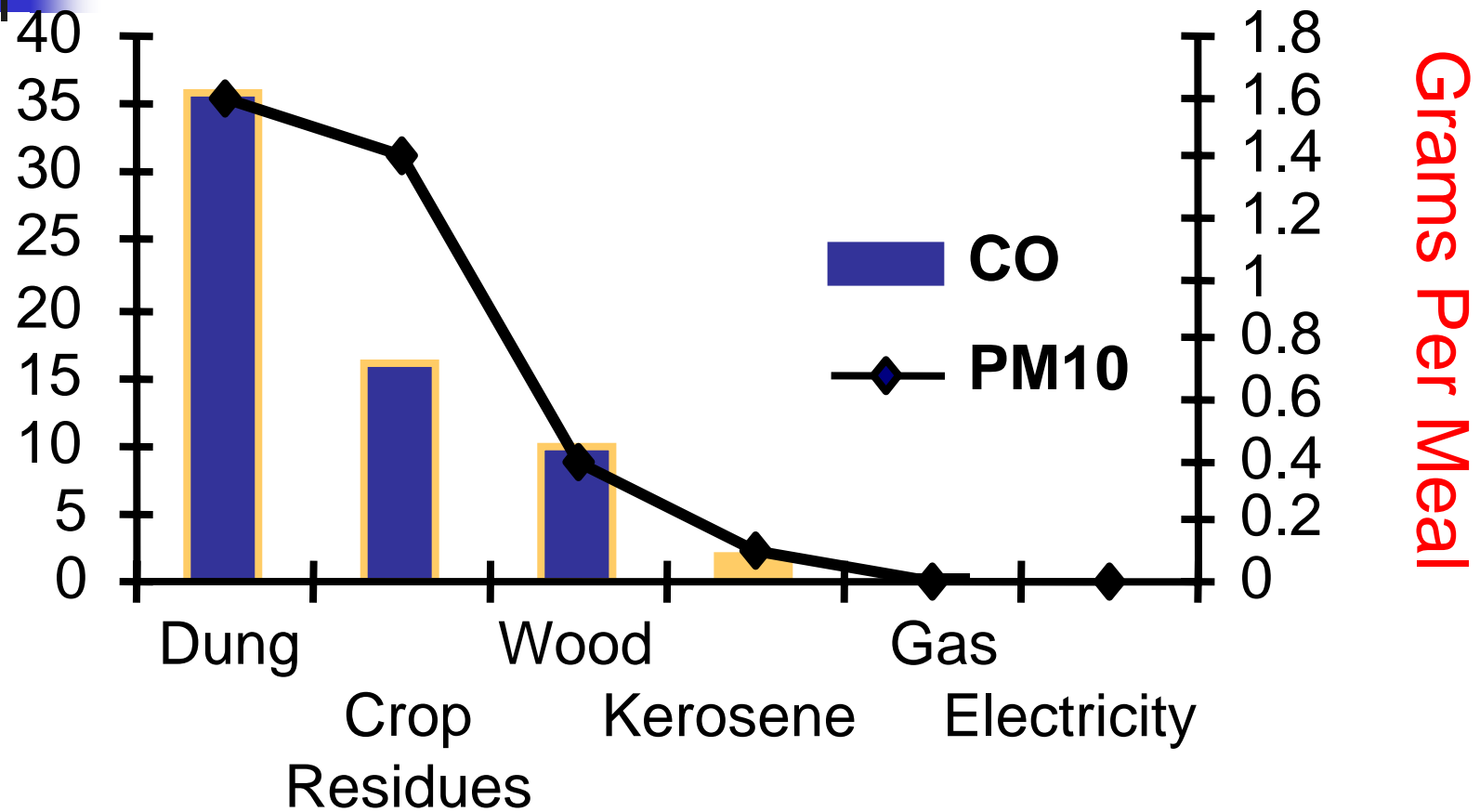
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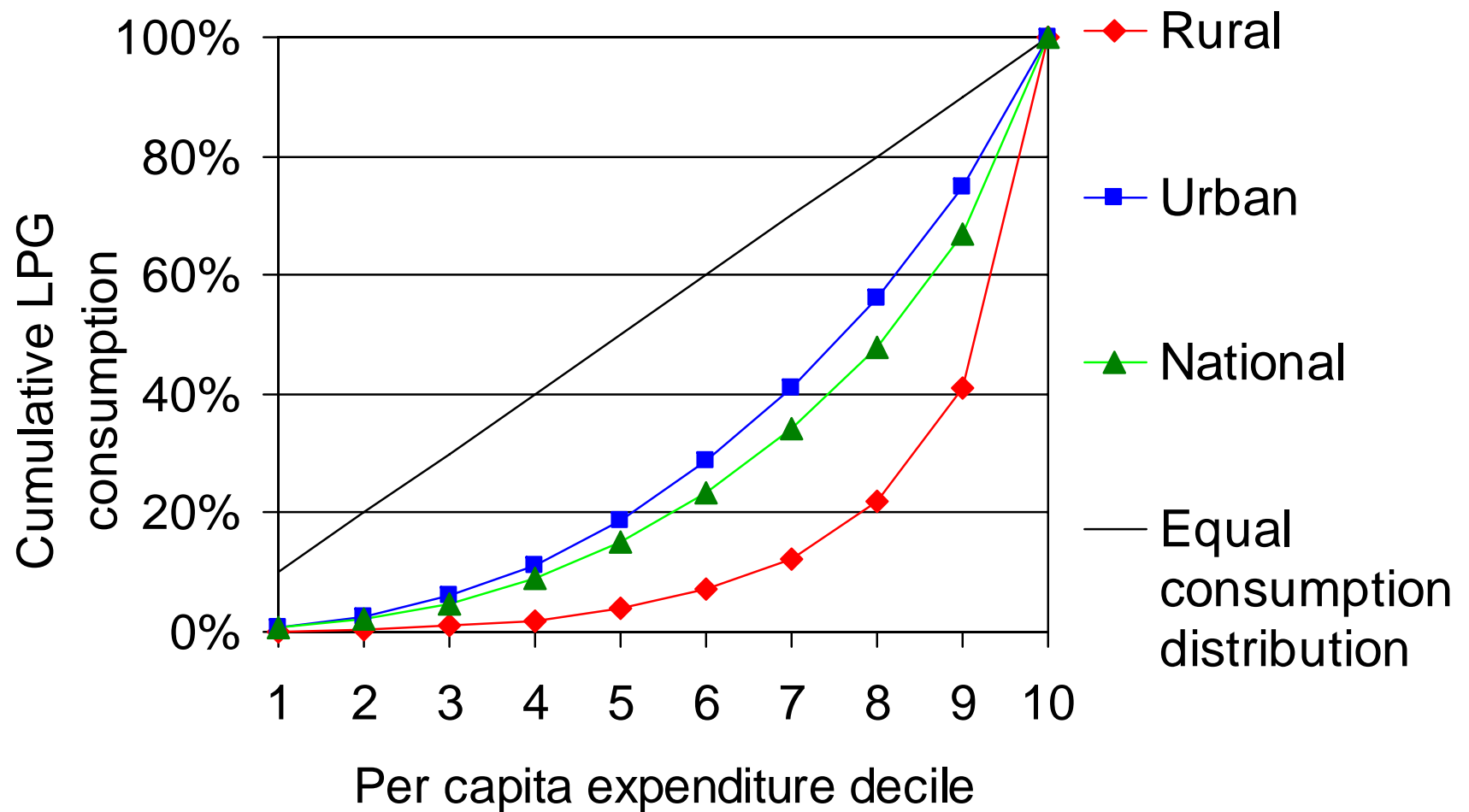


India: Emissions Along the Household Energy Ladder



India Income Effect:

LPG Use vs. per capita expenditure





Some findings

- Fully switching to liquid and especially gaseous fuels is the most effective way to reduce IAP to safe levels
 - More prevalent partial switching while continuing to use biomass does not have the same result!!!
- Cooking outside reduces levels but does not reduce exposure to safe levels
- A wide range of exposure levels in solid fuel using households with relatively low levels recorded in some households
- Factors affecting exposure are complex and need to be better understood

Switching to Clean Household Fuels: what we learnt



- Barriers to clean fuel switching
 - high start-up cost (cylinder deposit fee, stove purchase)
 - high and volatile fuel prices; “lumpy” fuel purchase payments (example: LPG),
 - difficult delivery logistics or lack of supply reliability
- Problems with designing effective targeted subsidy:
 - **Low budget priority** among the poor as long as free or cheap biomass options are available
 - Attractive for higher-income households and other uses (vehicles)
- Need to focus on:
 - Income generating alternatives to time spent on biomass collection
 - Raising awareness of health and other benefits of clean fuels and technologies
 - Designing rural energy programs that identify, meet and help sustain demand from users

Conclusion: Barriers to Overcome





What can be done?

A menu of options...

Solutions:

- Behavioral change
- Better Housing
 - Windows
 - Kitchen configuration
- Better Stoves
 - Chimneys & hoods
 - Fuel & combustion efficiency
- Better Fuels
 - “Clean” solids
 - Gases and liquids

Examples of interventions:

- Raising awareness of health effects and mitigation options
- Housing programs
- Improved stove programs
- Clean fuel promotion programs
- Cross-cutting themes:
 - Improving household economic status
 - Income opportunities for women
 - Female education
 - Level-paying field for private sector/rural entrepreneurs

Final Thought: Actual Filters from Bangladesh Study

